Using AIRS Data to Assess Hydrologic and Thermodynamic Budgets Associated with the Precipitation Variablity of the South-Asian Monsoon

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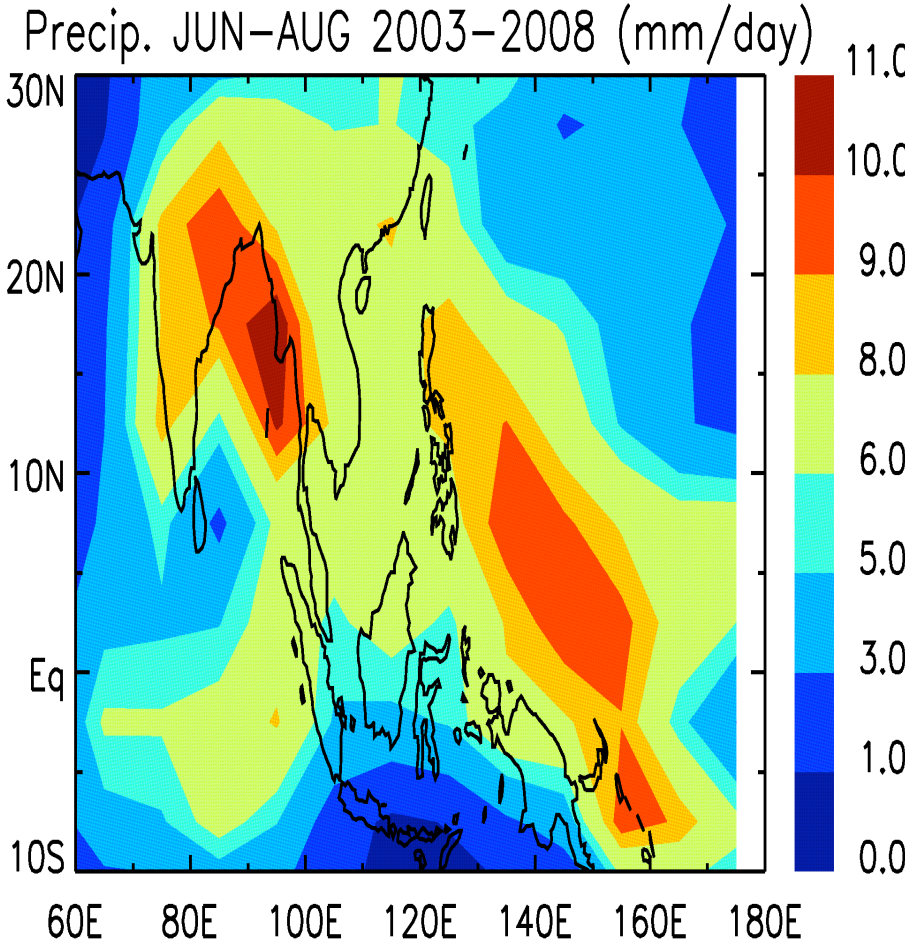
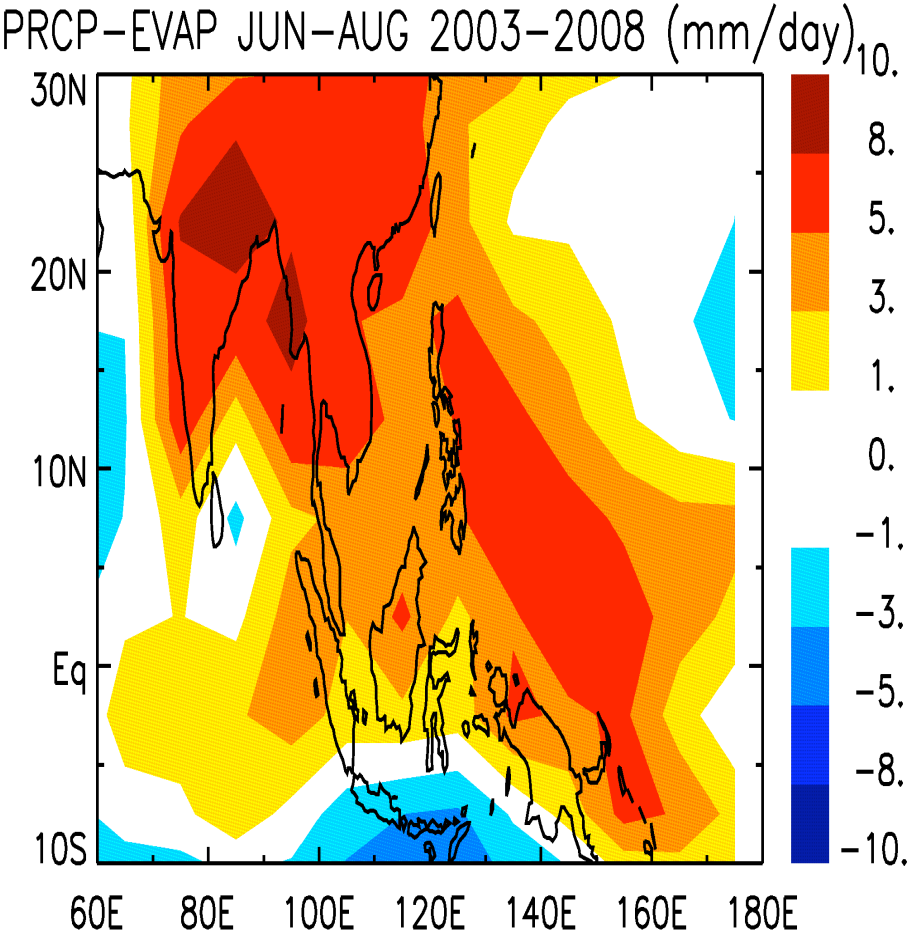
- Can AIRS q and T help explain global precipitation variability?
- Can AIRS provide precipitation related diagnostics for model evaluations?
- Use South-Asian (Indian) monsoon as an example

TRMM 3b42 Precipitation



TRMM 3b42 Precipitation – OAFlux Surface Evaporation



$$S = \partial[q]/\partial t + [u]\cdot\partial[q]/\partial x + [v]\cdot\partial[q]/\partial y + [\omega]\cdot\partial[q]/\partial p$$

$$= E - C - \partial[\omega'q']/\partial p$$

q: AIRS specific humidity (g/kg)
x, y, p: longitude, latitude, pressure coordinates
[ ] : averaged over a 10°×5° grid
u, v, ω: winds from GEOS5 MERRA
E, C, $-\partial[\omega'q']/\partial p$: Evaporation, Condensation, eddy term
S : In literature, it's related to –Q2

$$-\int S \cdot dp/g = \int (C - E + \partial[\omega'q']/\partial p) \cdot dp/g$$
$$\approx \int (C - E) \cdot dp/g$$
$$= \text{Precipitation} - \text{Surface Evaporation}$$

Comparison of Precipitation – Surface Evaporation (Summer)

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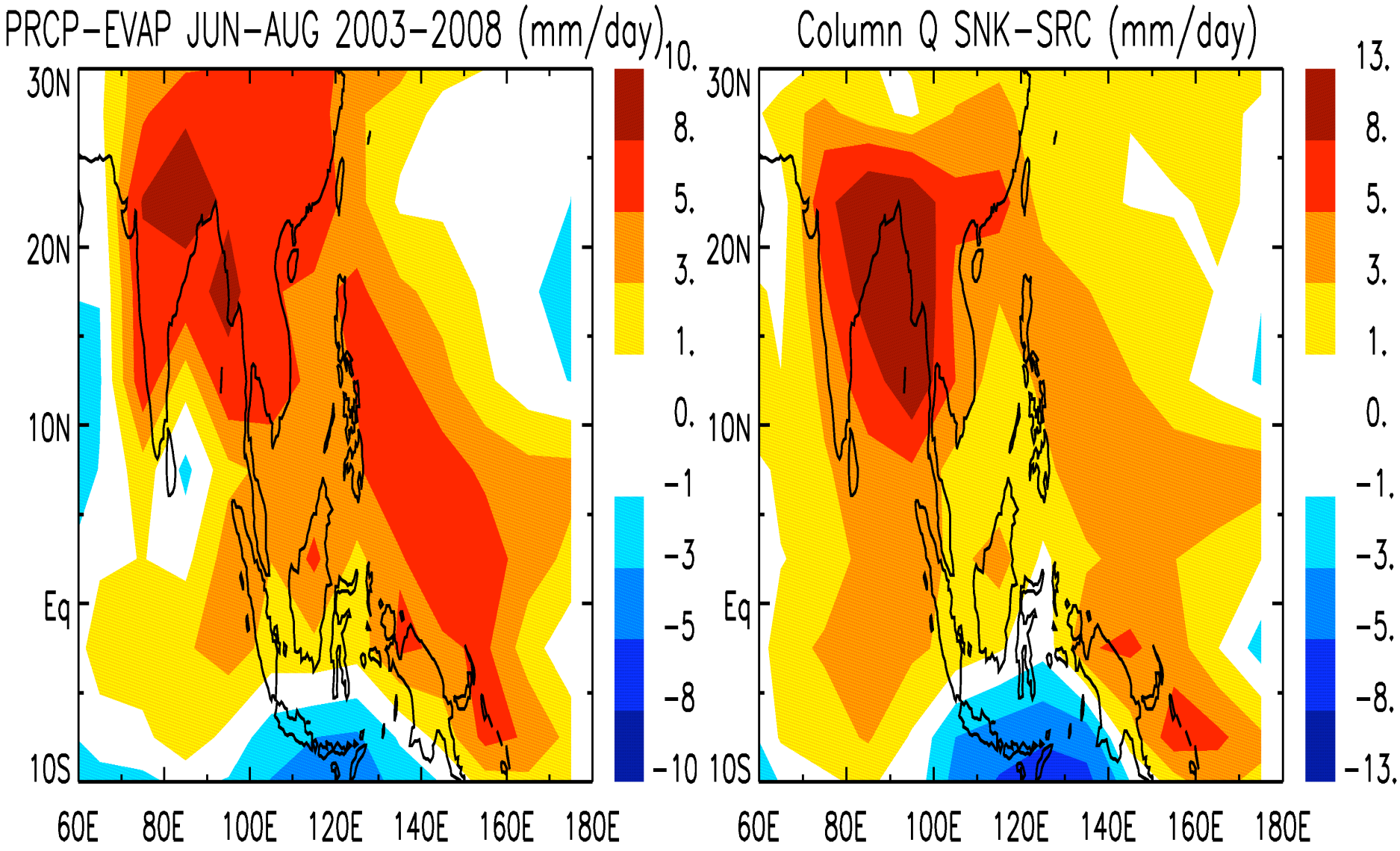
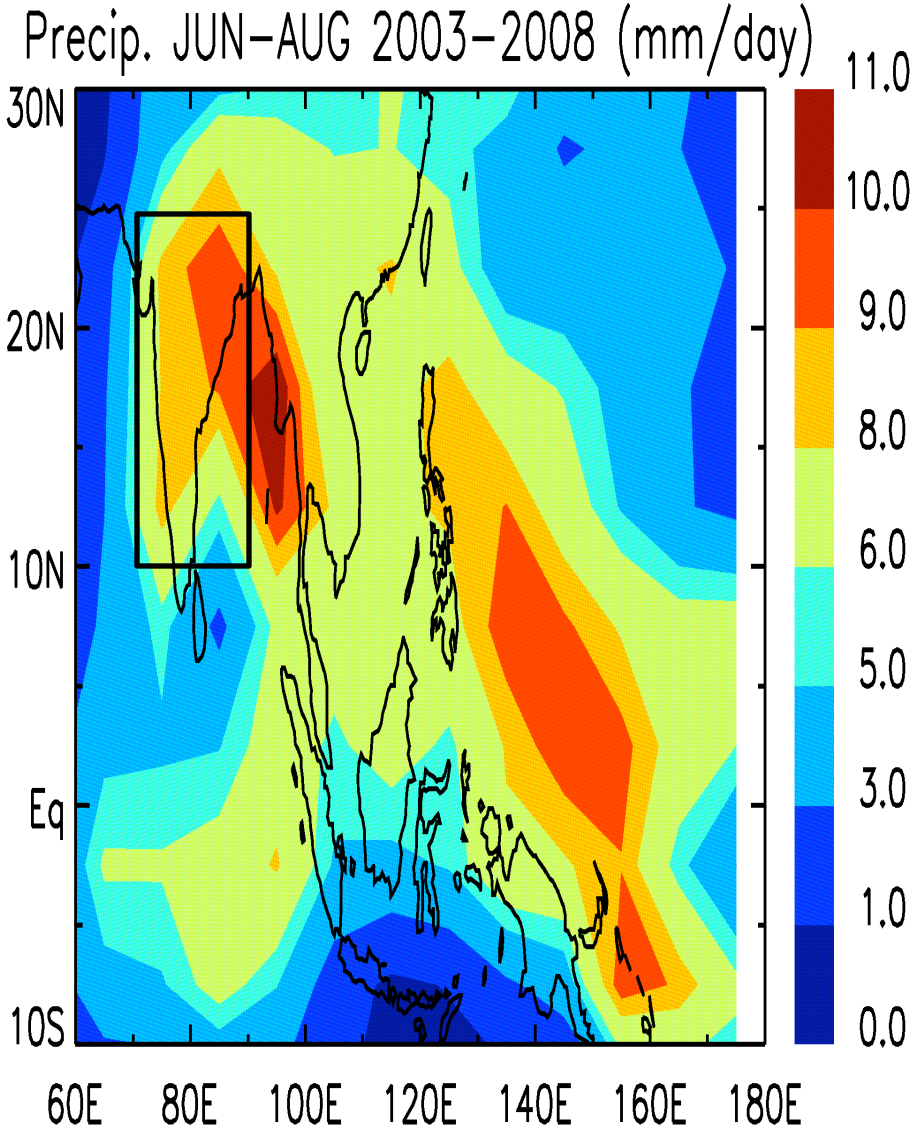
$-\int S \cdot dp/g$ from AIRS q and MERRA winds



- AIRS can reasonably account for seasonal averaged precipitation
- How about sub-seasonal variation (shorter time-scale) in precipitation?



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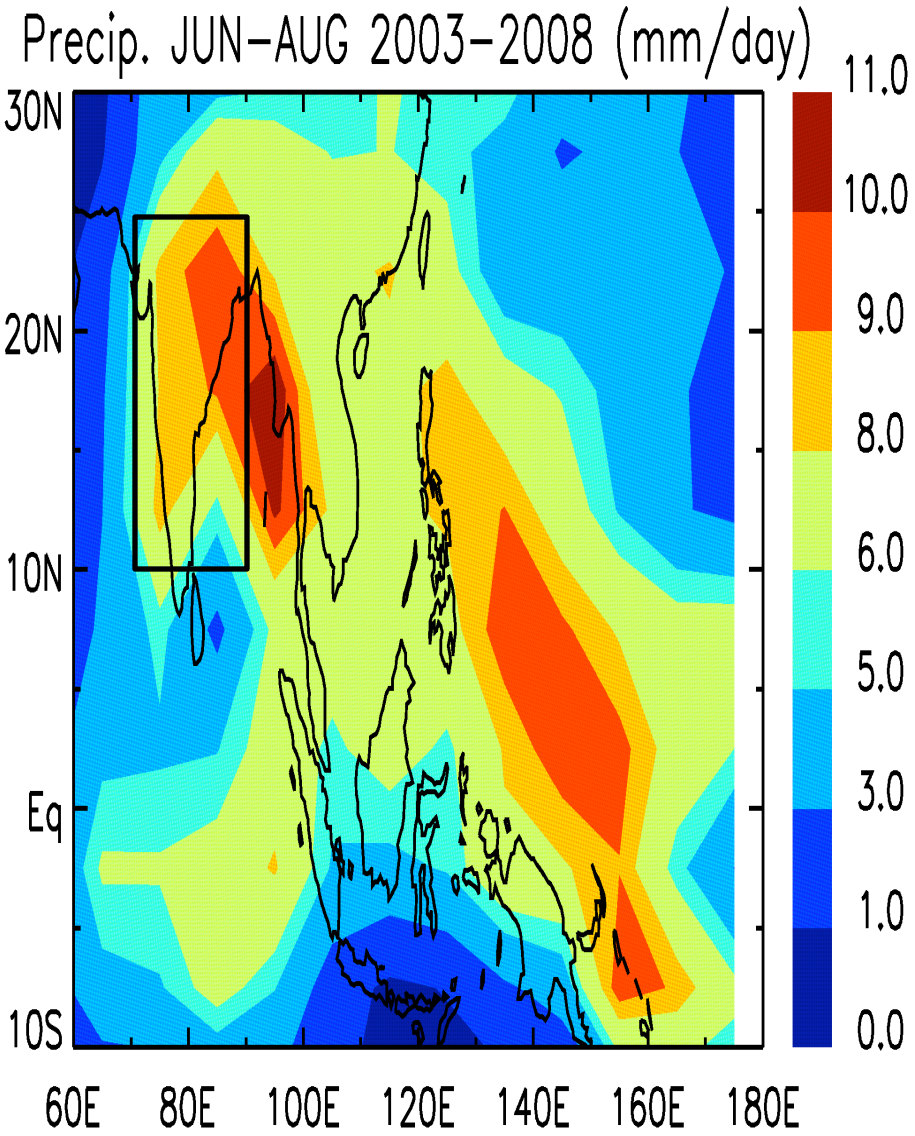

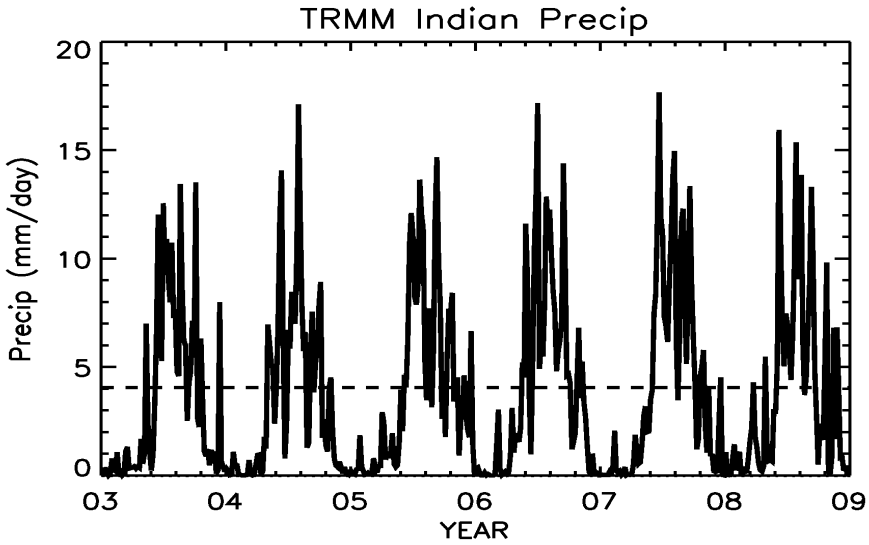

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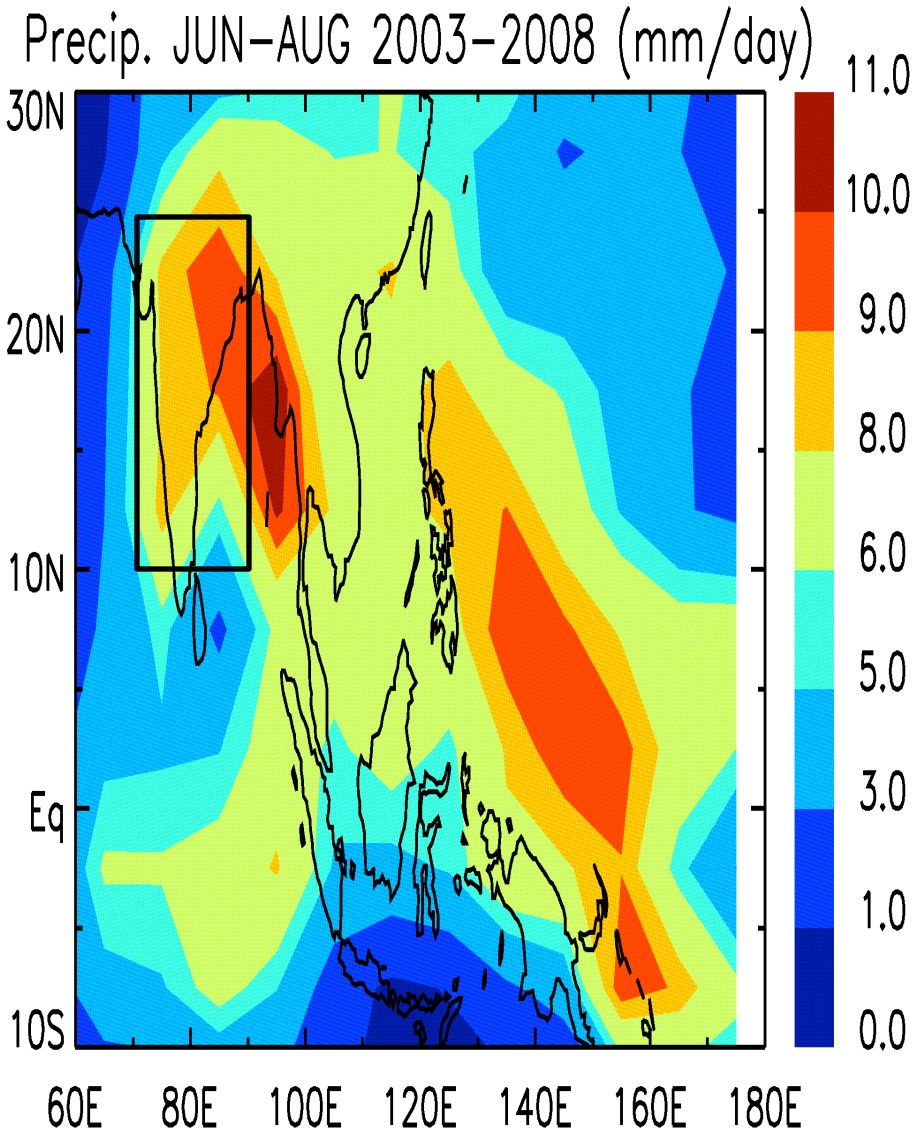
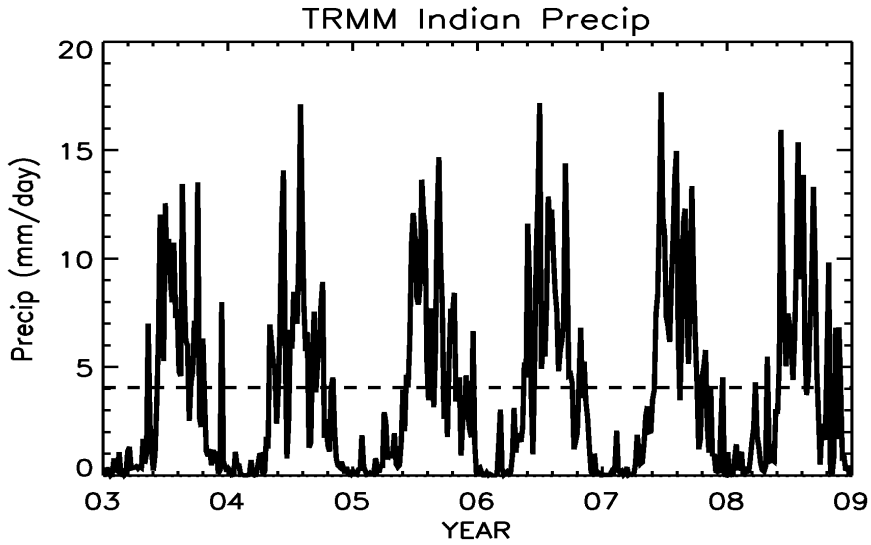
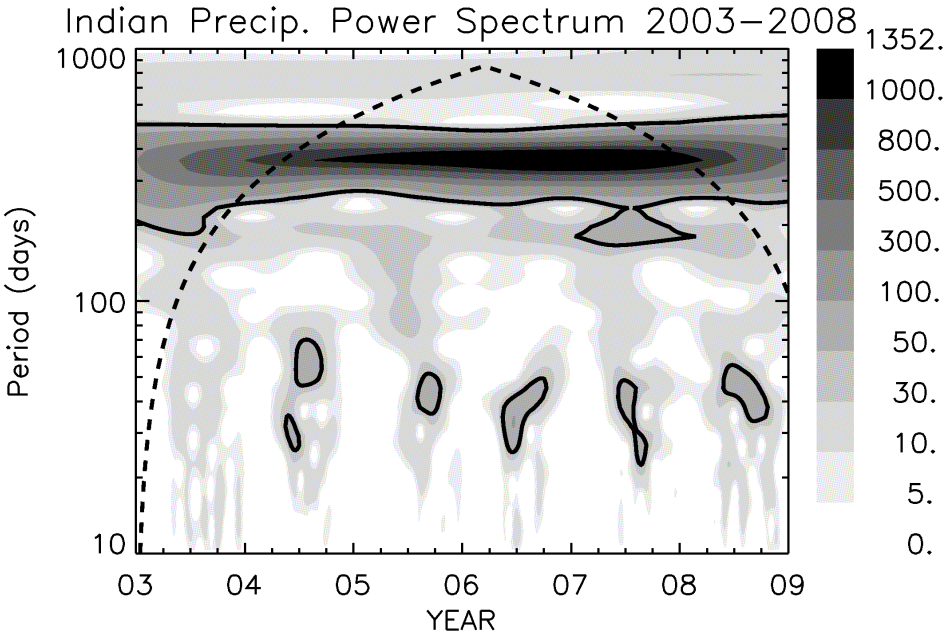
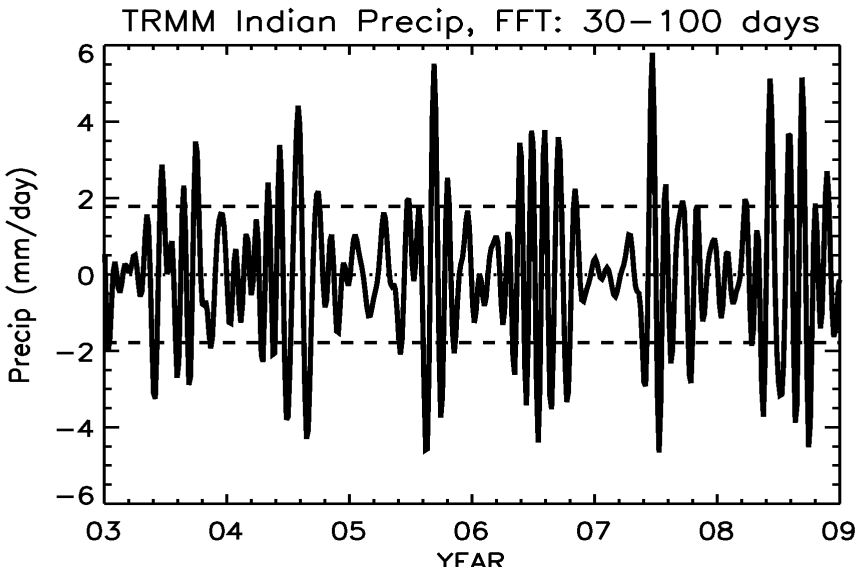
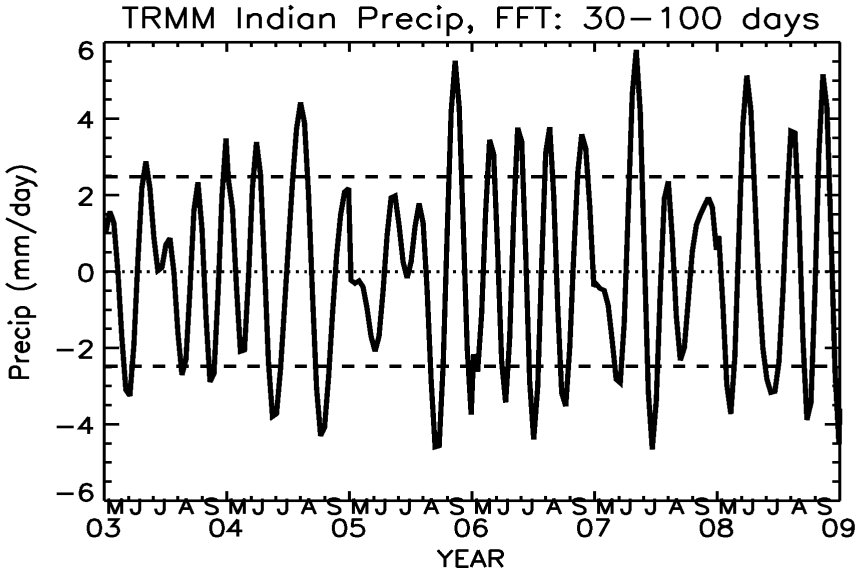






FFT Filter of Indian Precipitation 30-100 days
Hovmöller Diagram of Time Lag Composite of Anomalies





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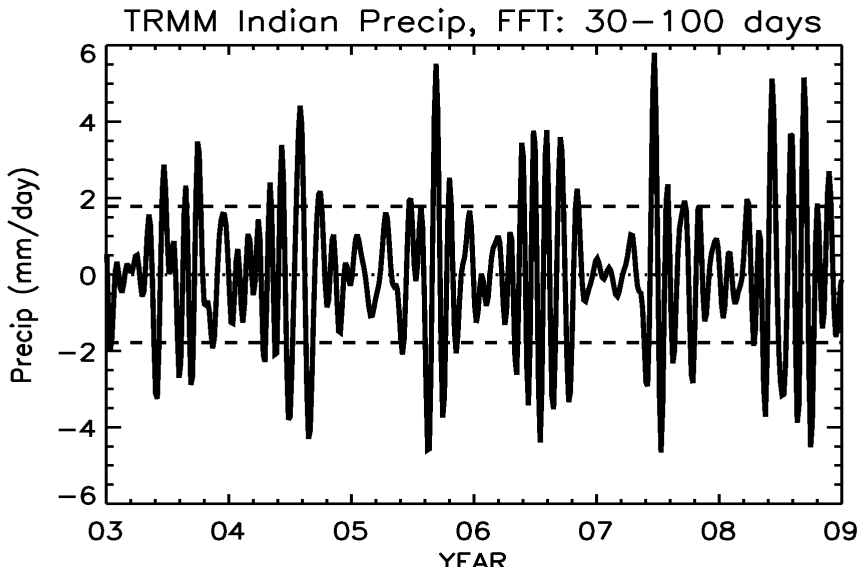

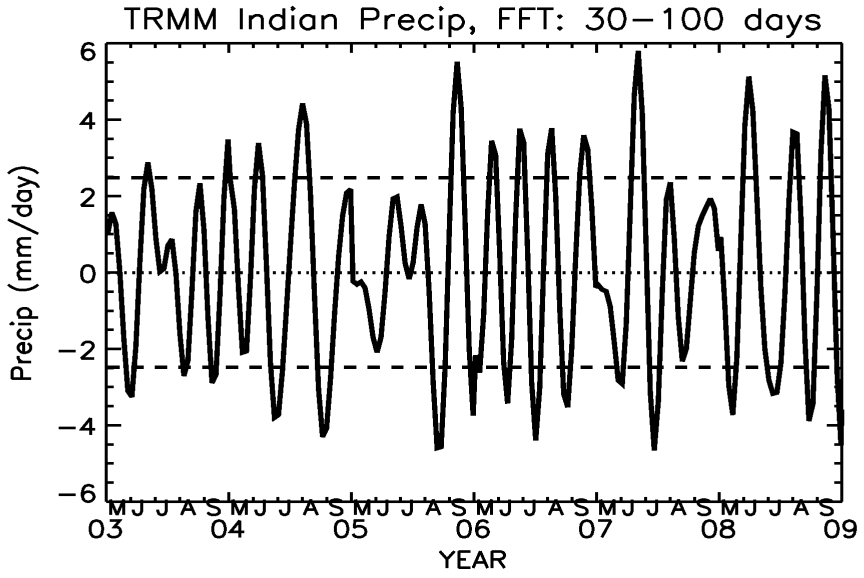

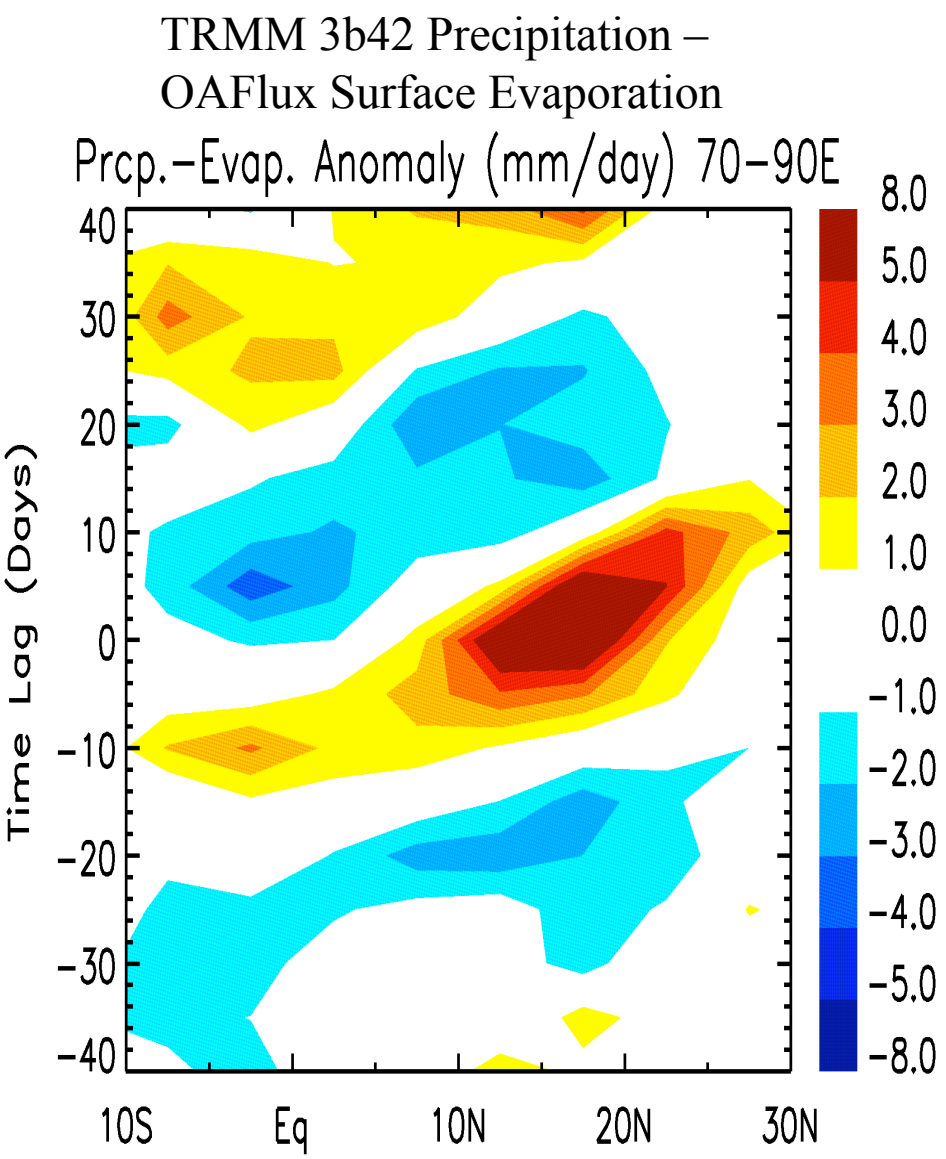

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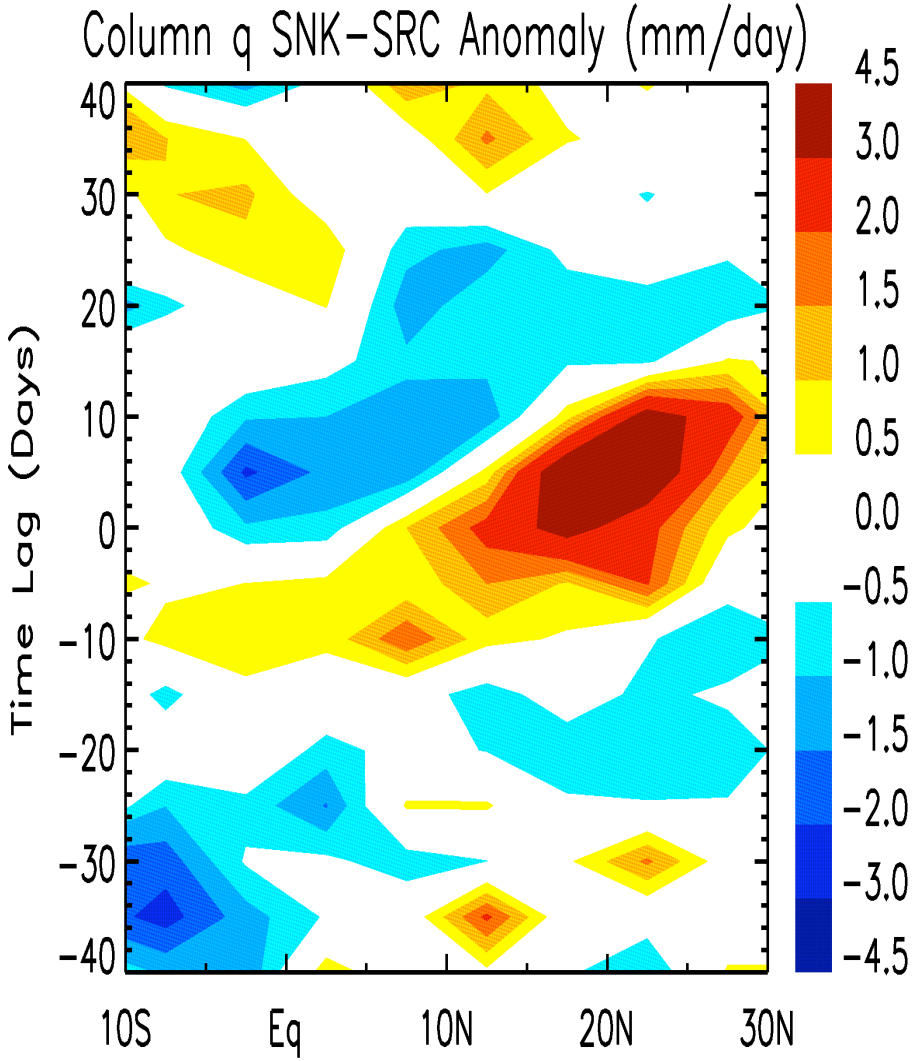

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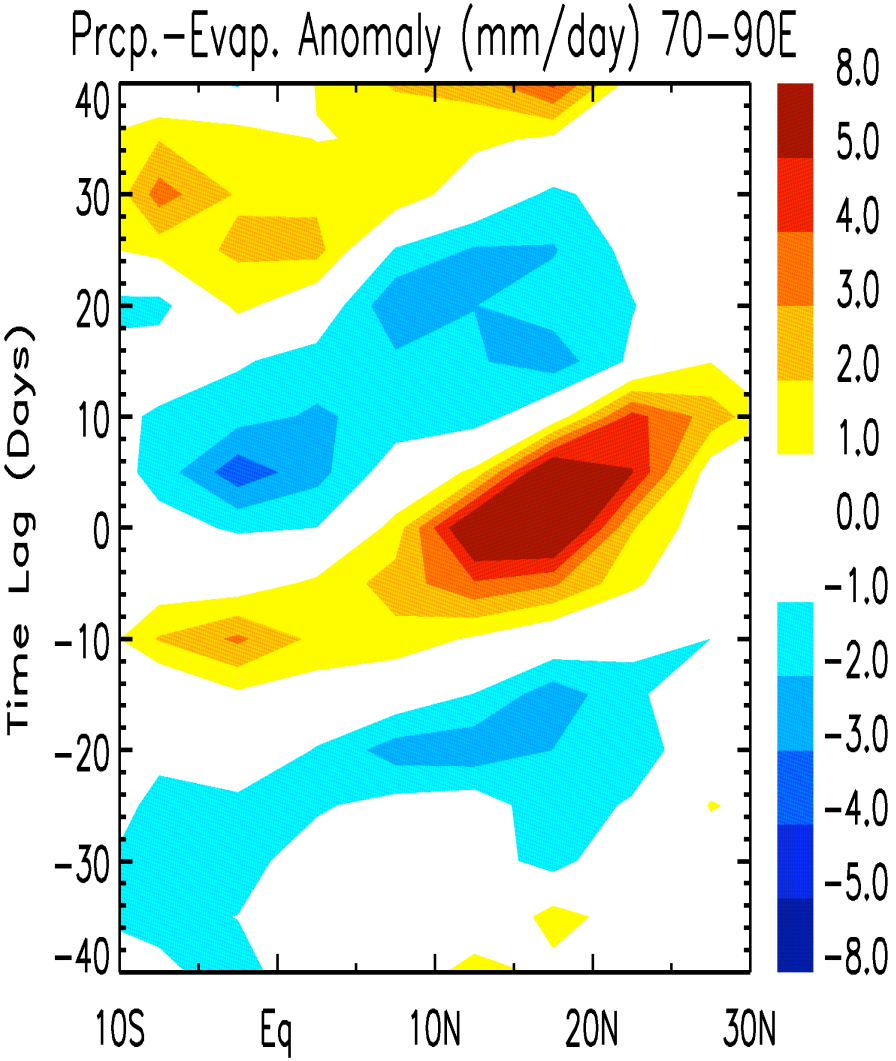
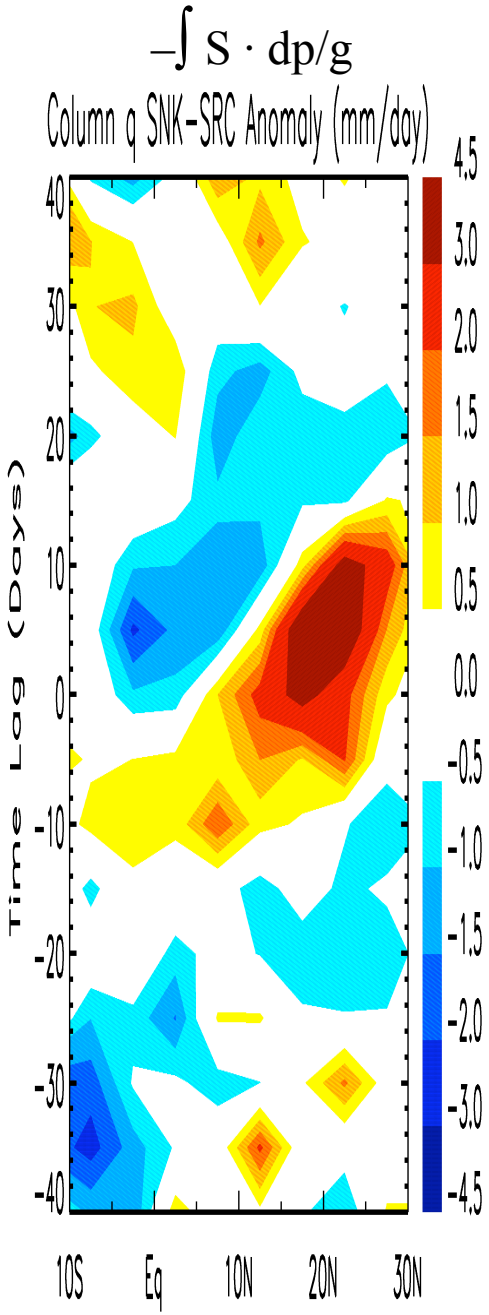


Hovmöller Diagrams of AIRS Precip. Related Variables' Anomalies (70°-90°E)



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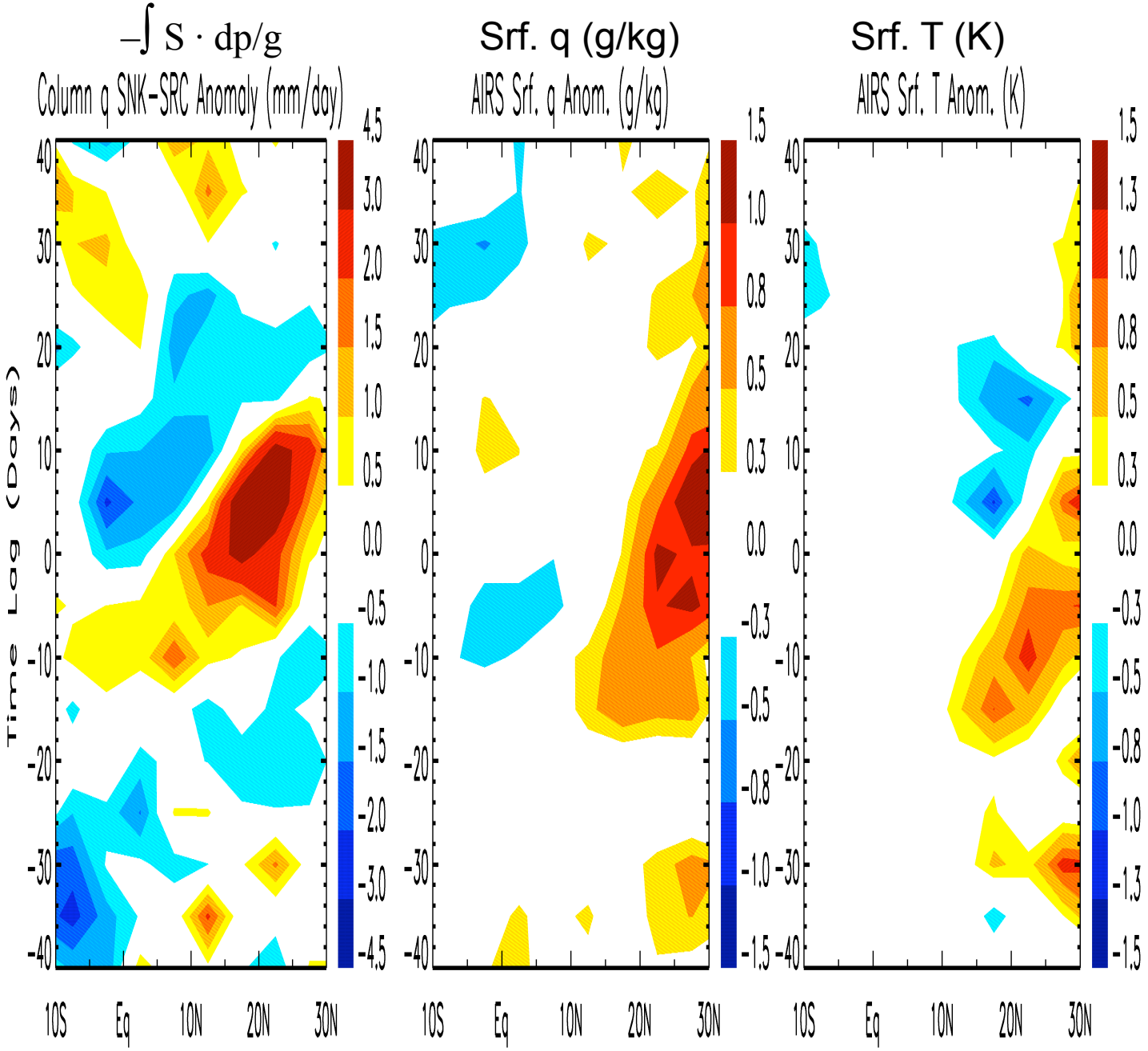

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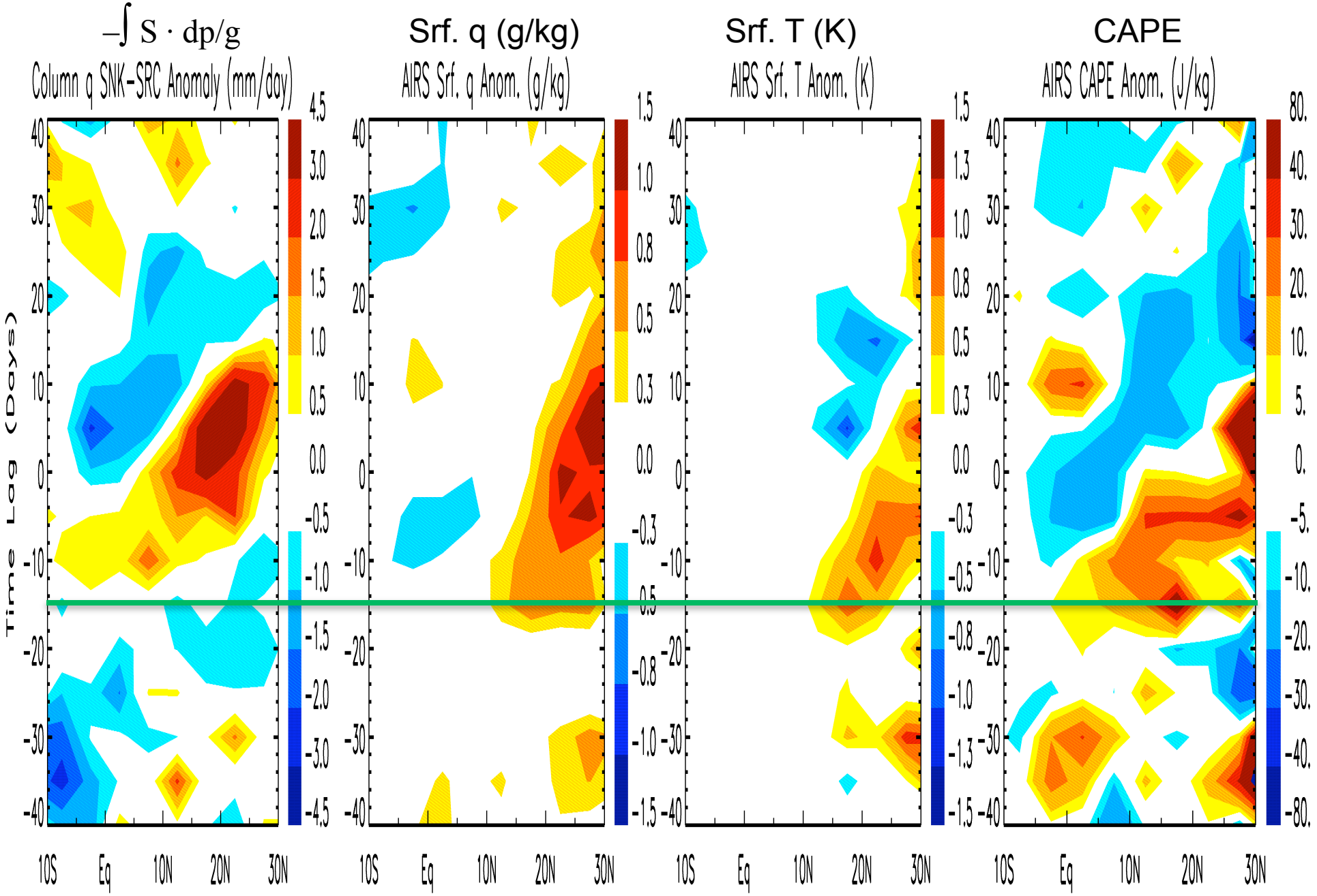
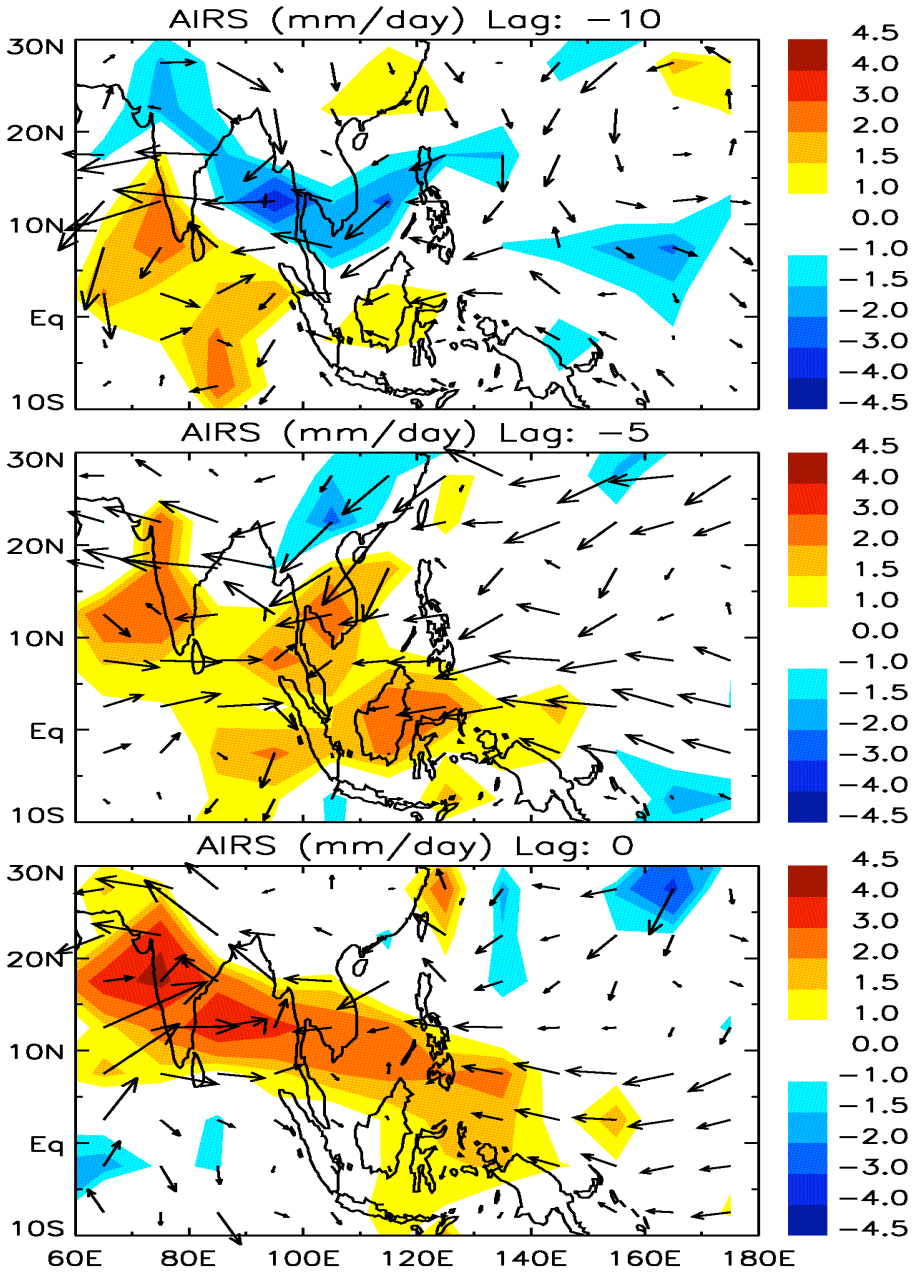


$-\int S \cdot dp/g$ from AIRS q and MERRA q flux



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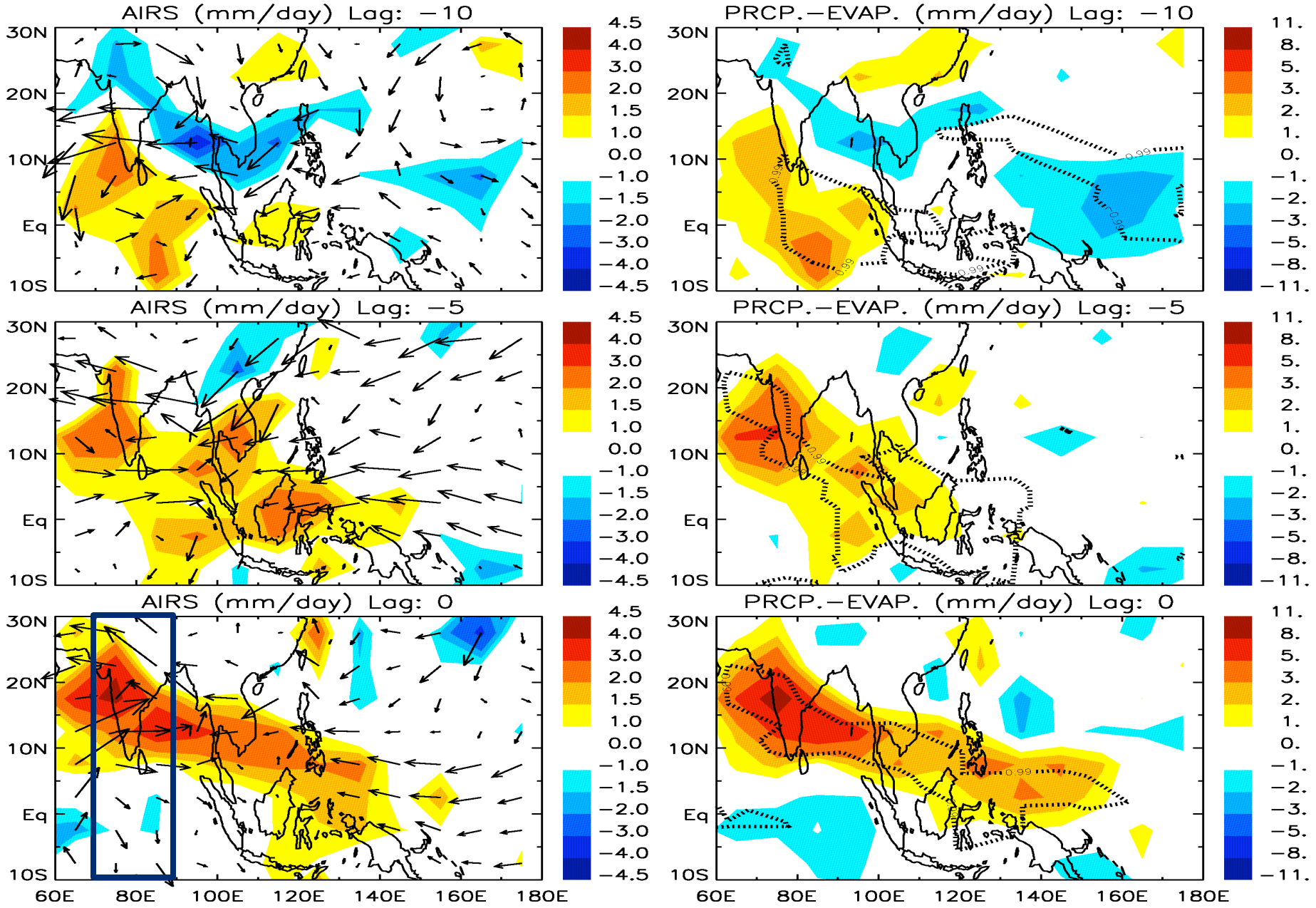
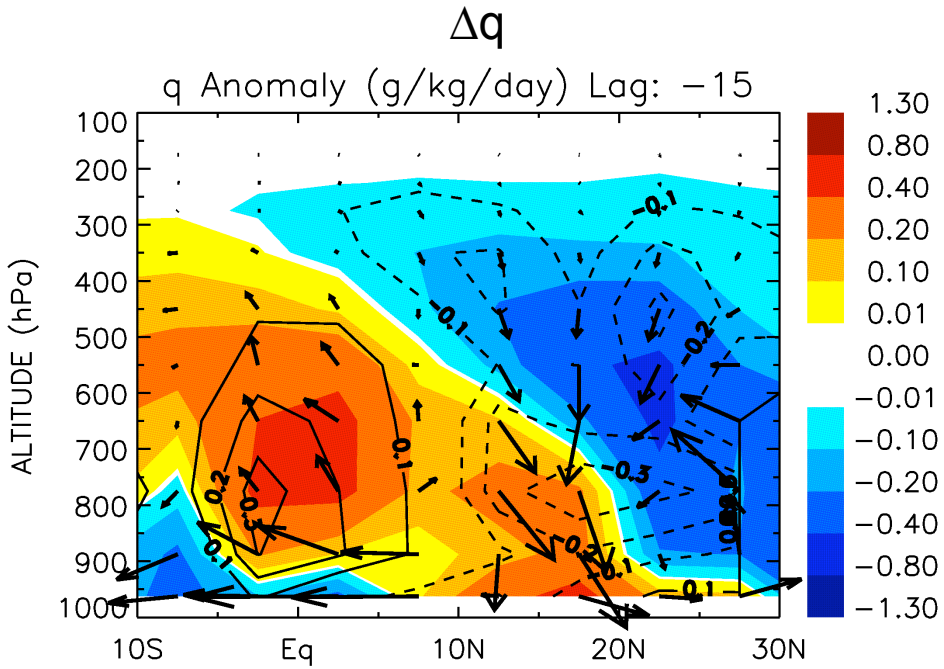


Altitude-Latitude Cross Section of 70°-90°E, Time Lag –15 Days



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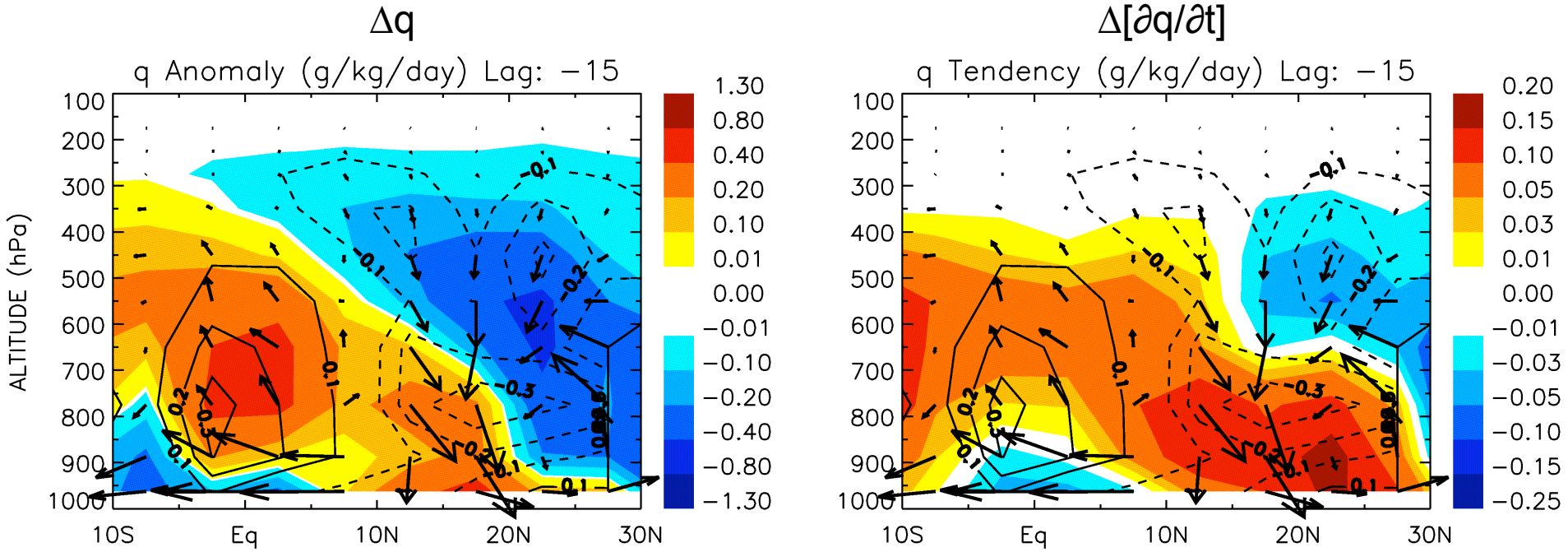

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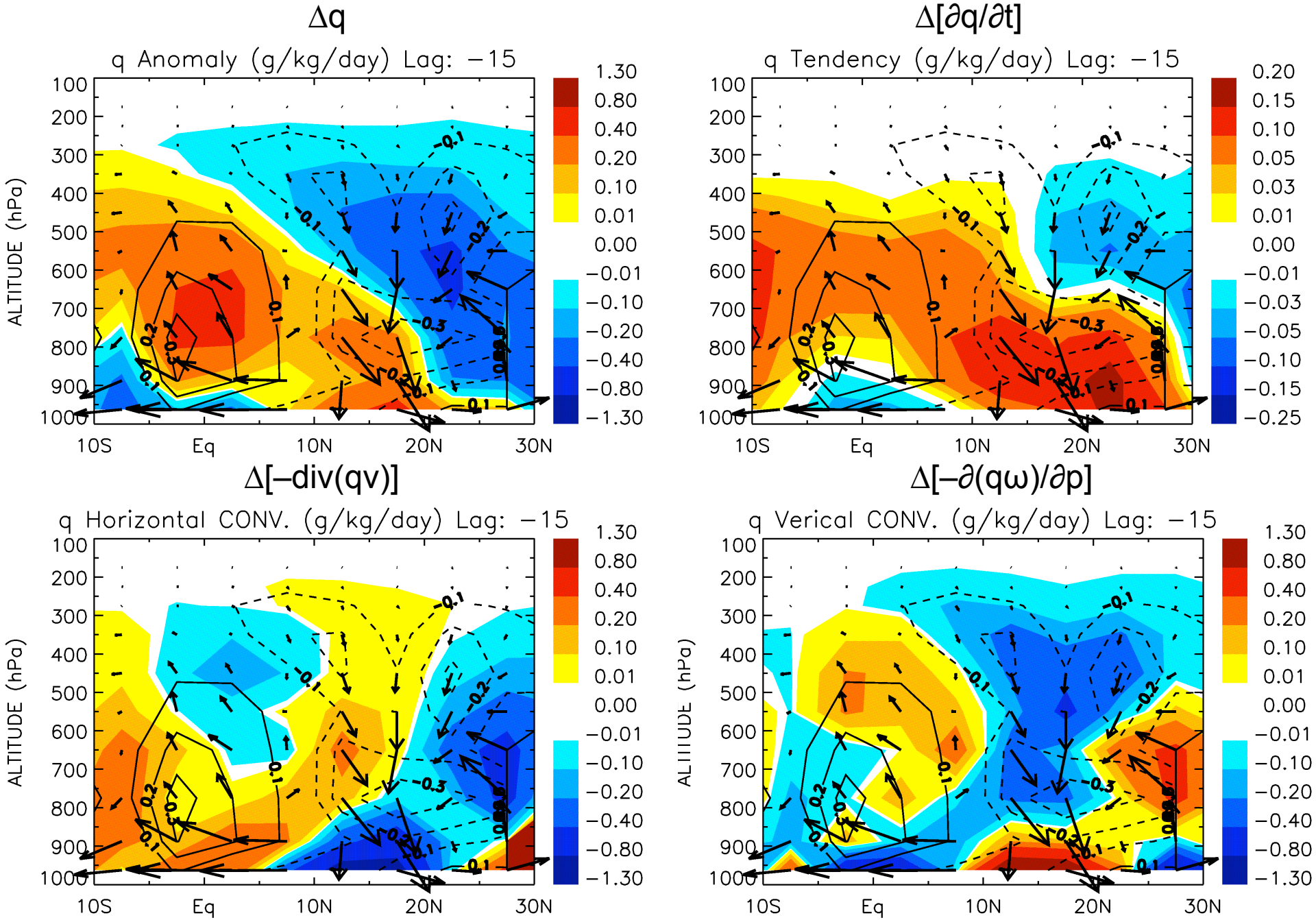

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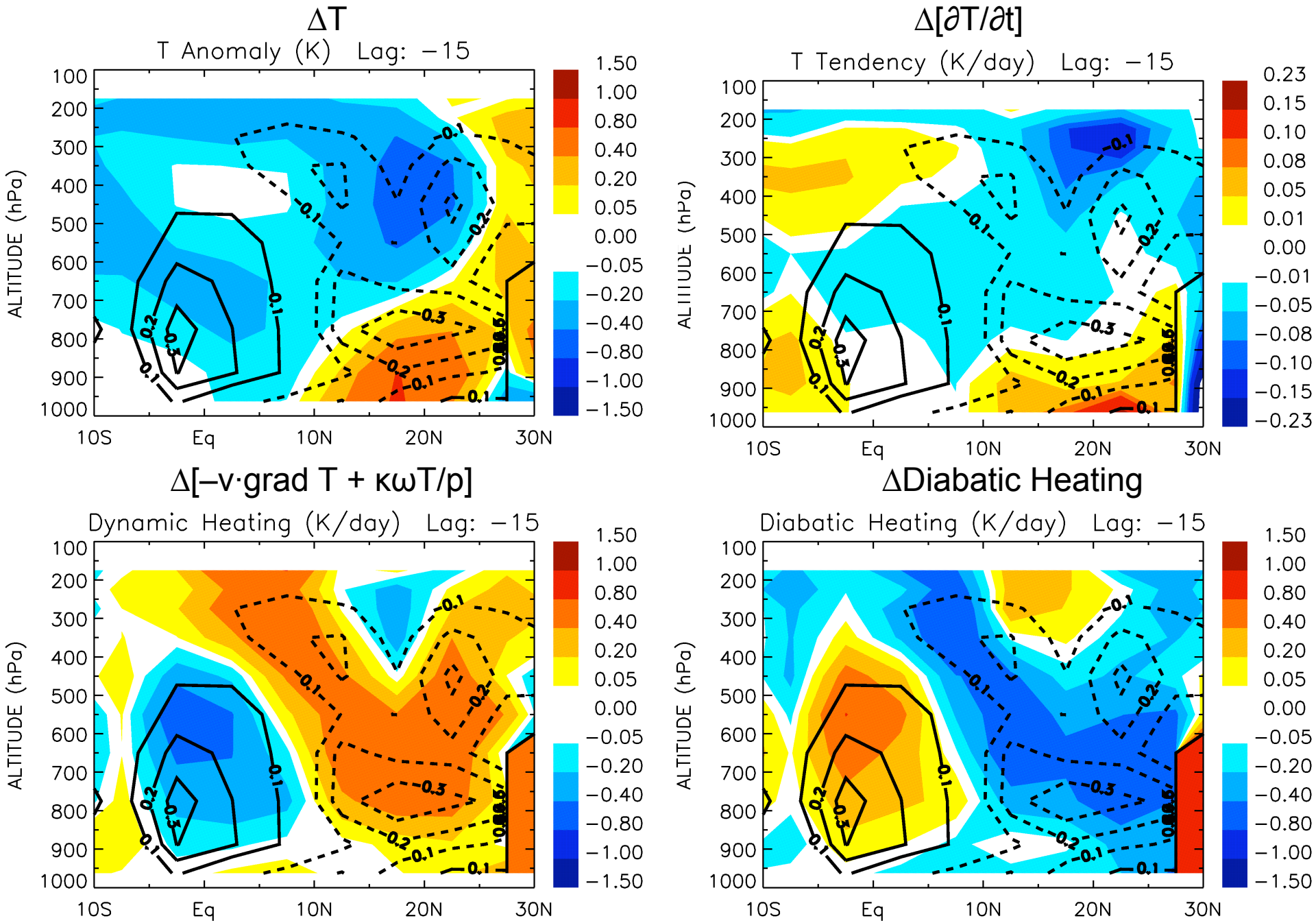

Conclusion:

The short-term summertime precipitation variation over India is associated with

• The 30-100 days period of tropical convection

• When the tropical convection is located over Indian Ocean → enhanced Hadley Circulation → moistening and heating lower troposphere over Indian continent → distabilize the atmosphere over the Indian continent

• AIRS diagnostics consistent with the suggested mechanism of *moisture-convection interaction*

Future Work:

• Compare the inferred AIRS/AMSU diabatic heating rates with TRMM latent heat dataset (e.g., Spectral Latent Heat, SLH)

Altitude-Latitude Cross Section of 70°-90°E, Time Lag 0 Days